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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003900349 for a patent by SCALZO AUTOMOTIVE RESEARCH P/L as filed on 28 January 2003.

WITNESS my hand this
Twentieth day of January 2004

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PISTON DE-ACTIVATION MECHANISM FOR INTERNAL COMBUSTION ENGINES.

This invention relates to internal combustion engine mechanism for improving fuel economy during part load operation.

Conventional internal combustion engines (ICE) are generally configured in an in-line, horizontally opposed or in a V formation. In a vehicle installation they are sized in volumetric capacity to achieve the desired maximum speed and acceleration requirements. This engine size generally means that at low load conditions, deceleration and braking periods, which is majority of the time, the fuel consumption is high because the engine needs to be throttled.

Many attempts have been made to reduce the capacity of the engine during low load conditions by variable stroke mechanisms, and cutting off fuel to some of the cylinders, however, most have not been successful. In the case of shutting off fuel to some of the cylinders, this method has produced some improvements but because the pistons are still moving, thus creating friction, the maximum benefits have not been derived.

It is the object of this invention to present a means of completely de-activating and re-activating the pistons individually or in groups while the engine is in motion at a very fast rate as demanded by the vehicle via sensors and an engine management system.

This invention is particularly directed at V-type of multi-cylinder engines where one bank of cylinders can be made to run continually, while the other bank of cylinders can be de-activated and re-activated either one-at-a-time or in groups.

The mechanism is presented by three drawings in which:

Figure 1 is a vertical cross section of one piston/crank assembly of a multi-piston V-type engine with all pistons in the active position.

Figure 2 is a horizontal cross section, Section A-A, of the engine in Fig. 1 through the output crank and main components of the mechanism. It also shows the offset of cylinders between the two banks, typically found in V-type engines

Figure 3 is a vertical cross section of the piston/crank assembly of a multi-piston V-type engine with one of the piston in the opposite bank in the de-activated position.

It is to be understood that a complete engine must have one bank of pistons that remains active at all times. The opposite bank of a multi-piston V-type engine can have the pistons de-activated by the mechanism described below, and each piston can be deactivated separately as required. It is expected that such an engine will provide substantial fuel economy, particularly in city driving conditions.

Referring to Figs. 1 and 2, the engine mechanism 10 is housed in crank case 12. Piston assemblies 14 and 16 move in bores 18 and 20 respectively. Piston assembly 14 connects to the rocking member 22 via connecting rod 24 and parallel links 26. Connecting rod 24 is rotatable on gudgeon pin 28 connected to the piston 14, and pivotally connected to links 26 via pin 30. The other end of the links 26 is rotatably connected to the rocking member 22 via pin 50. The two links 26 straddle the connecting rod 24.

Piston assembly 16 connects to the rocking member 22 via connecting rod 32 rotatable on gudgeon pin 34 connected to the piston 16, and pivotally connected to rocking member 22 via pin 36.

Rocking member 22 is pivotally connected to the crankcase 12 via two trunnion pins 38 and 40 fixed to the crankcase 12, and via bearings 42 and 44, at a suitable mid point between the two banks of cylinders to provide articulation of the con rods 24 and 32 as the respective pistons 14 and 16 move through their stroke limits.

The rocking member 22 is connected to the crankshaft 46 via connecting rod 48. The small end of connecting rod 48 is pivotally mounted by pin 50 between the two links 26. However, the con rod 48 can also be connected to other points on the rocking member 22 to suit different configurations. The big end of the connecting rod 48 connects to the crankshaft 46 via crankpin 52.

Thus piston 14 motion is transferred to the crankshaft 46 via connecting rod 24, links 16, rocking member 22, oscillating on trunnion pins 38 and 40, and connecting rod 48. The geometry of the linkage system is represented in Fig. 1 showing the piston 14 in approximately the mid stroke position with piston 14 stroke determined by the position of trunnion pins 38 and 40, pins 30 and 50, and the throw of crankpin 52.

The connection at 30 by connecting rod 24 and links 26 is held in position against a stop 54 fixed in rocking member 22, by the hydraulic piston ram 56, not fully detailed as it is a conventional piston and cylinder type and similar to the unit more fully described in provisional patent application 2003900003. The hydraulic ram 56 is pivotally mounted in two positions, with the piston rod pivotally mounted on the rocking member 22, and the cylinder pivotally mounted between the two links 26. In the position of Figure 1, the hydraulic ram 56 is fully extended representing activation of the piston 14. Hydraulic oil passages are machined in the rocking member 22 and on either side of the trunnion pins 38 and 40 (not shown), to an external hydraulic control system (not shown).

The angled position of connecting rod 24, as it moves through the stroke ark, is such that when the piston 14 is in the top dead centre position (TDC), connecting rod 24 is toggled with links 26 and keeps the piston 14 against stop 54.

To de-activate piston 14 reference is made to Figure 3, in which the hydraulic ram 56 is retracted by the hydraulic circuit and control system (not shown), pulling the connection at pin 30 formed by links 26 and connecting rod 24 against stop 58 fixed to rocking member 22. This position of pin 30 is concentric with the trunnion pins 38 and 40 allowing rocking member 22 to oscillate without imparting any motion to the piston 14. The fixed stroke piston 16 and other parallel pistons in its cylinder bank, continuing the rotational motion of the crankshaft 46.

It is understood that upon any of the piston de-activation fuel is cut off to that cylinder and re-supplied upon activation.

In V-type engines, it is common for the two banks of cylinders to be offset to allow connection of the connecting rods to the crankshaft and for compactness. This feature is also beneficial for the de-activateable engines described in this invention. Referring to Figure 2, the offset cylinders are represented by thick lines 60 and 62 and allow the crankshaft 46 to be closely coupled to the rocking member 22 via pin 50.

In a V-6 cylinder engine, for example, three cylinders are at fixed stroke piston and three de-activateable (D-A) pistons. With the engine in the idle or with vehicle under deceleration and braking condition, only the fixed stroke pistons need be active. During acceleration, each D-A piston can be activated in sequence to allow smooth introduction of power. During cruising conditions, only the number of pistons required, running at optimum efficiency need to be active. Under these operating condition considerable fuel savings will be achieved.

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The scope of the invention need not be limited to the mechanism shown, Variations in the positioning of the crankshaft and the rocking mechanism and the method of altering the position of the linkages, either by hydraulic or mechanical systems, and in addition, the geometry of the linkages to achieve the same outcome, fall within this invention.

Also, the hydraulic ram 56 can be replaced by a hydraulic rotary actuator the output shaft of which, is fixed and concentric with pin 50. If this system is used, links 26 are fixed to pin 50. Pin 50 becomes pivotally connected to rocking member 22.
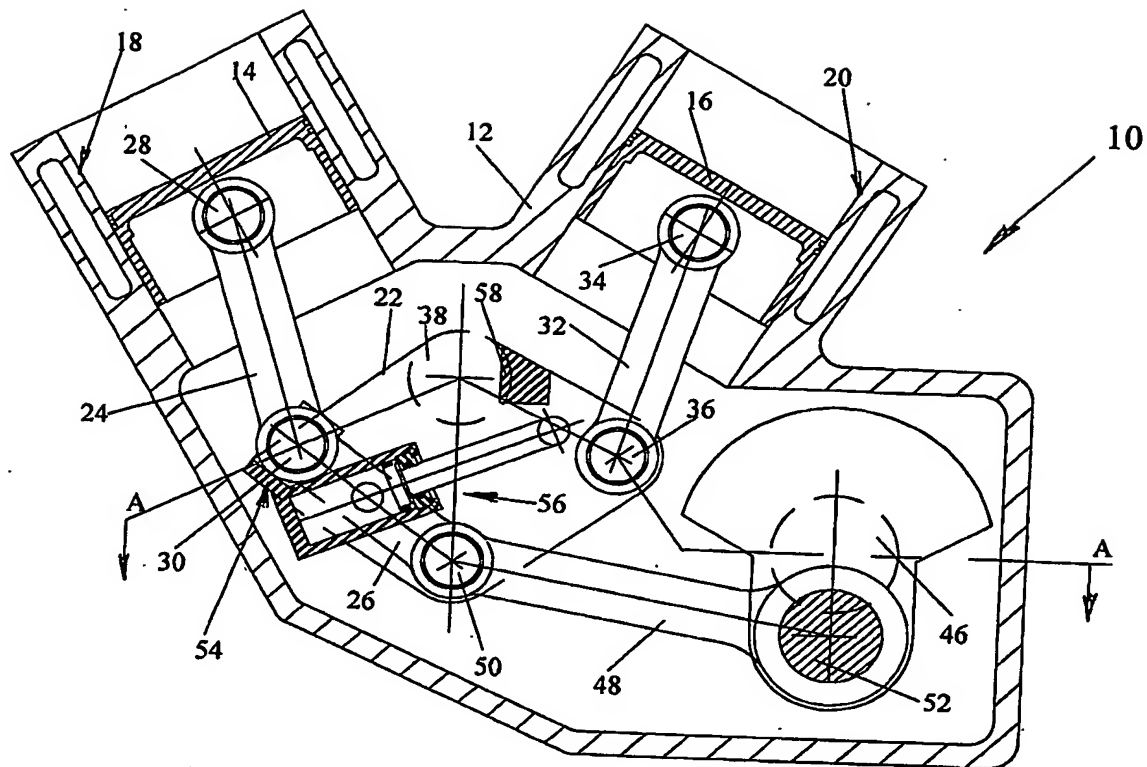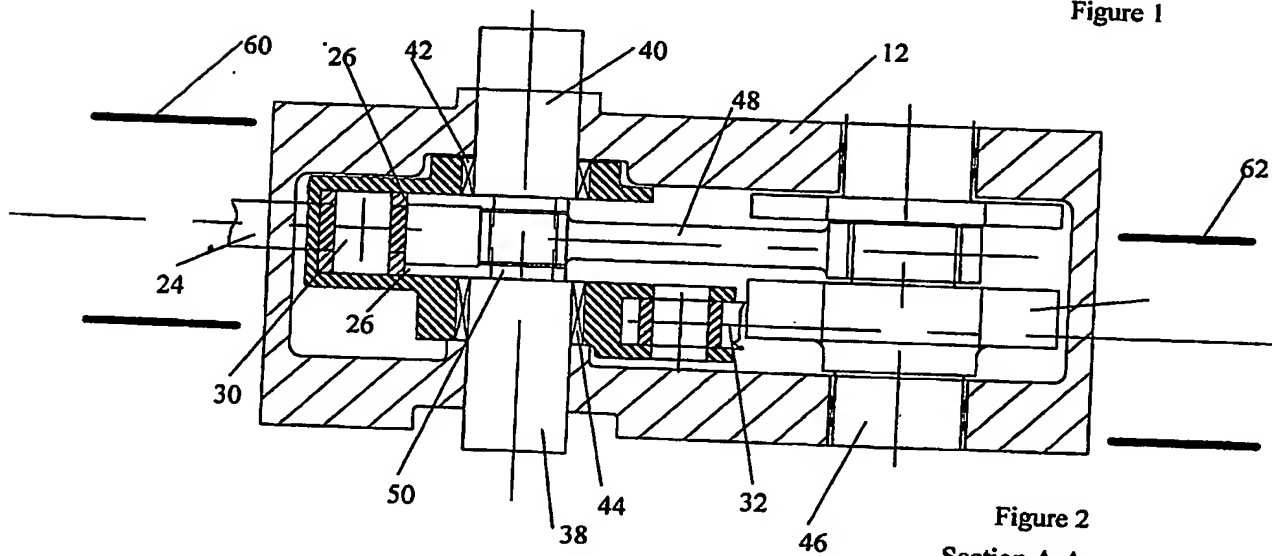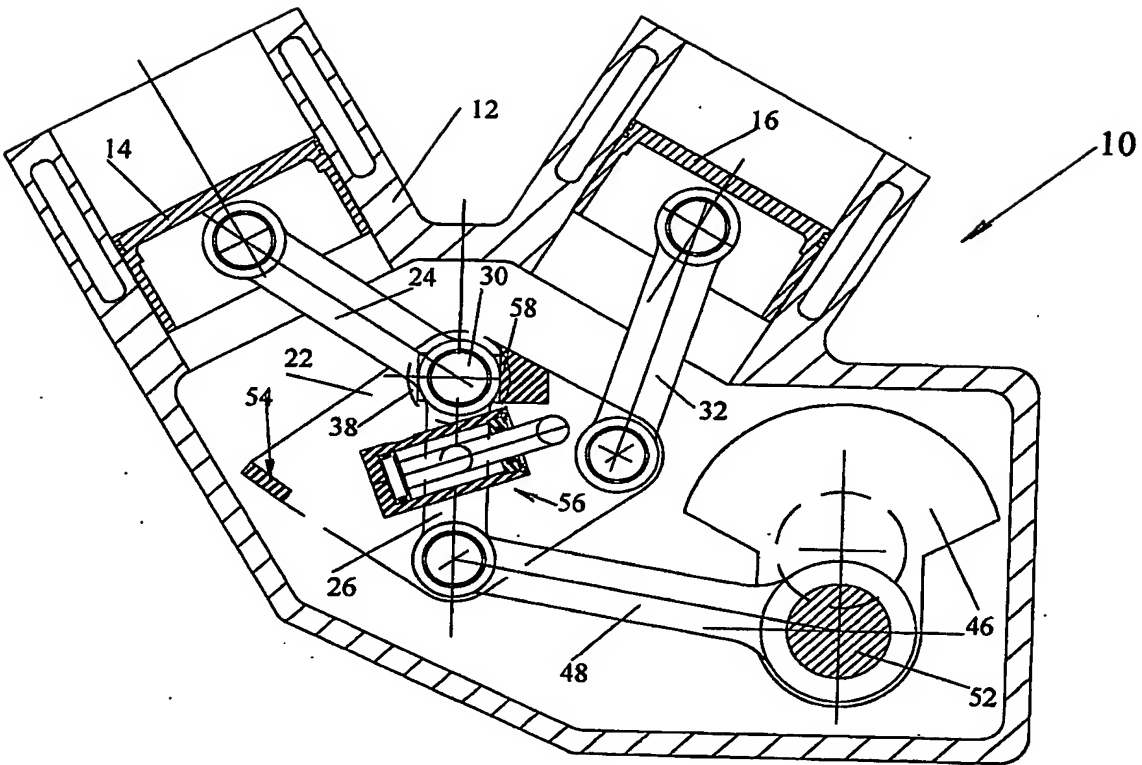
Figure 1

Figure 2
Section A-A

Figure 3